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TUPOLEV 144 AND CONCORDE - THE OFFICIAL PERFORMANCES ARE COMPARED FOR THE FIRST TIME

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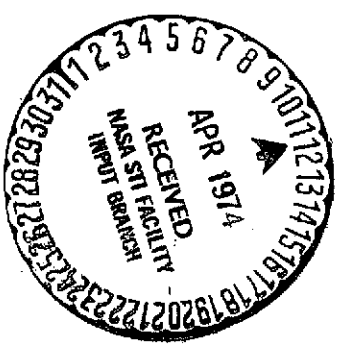


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546 APRIL 1974

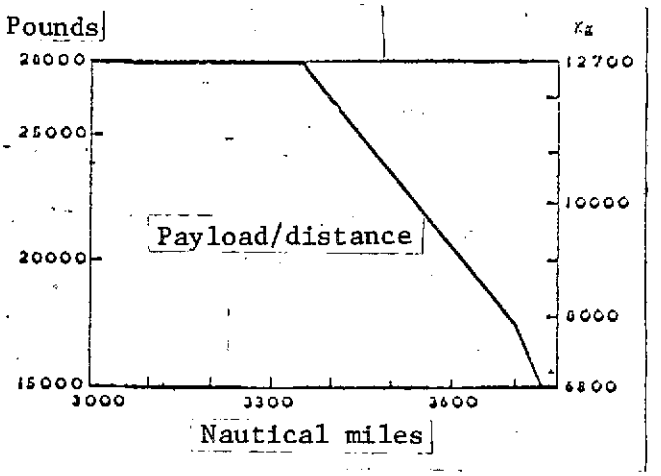
TUPOLEV 144 AND CONCORDE - THE OFFICIAL PERFORMANCES ARE COMPARED FOR THE FIRST TIME

Jacques Morisset

In our last issue we published for the first time the official characteristics of the Concorde and the TU 144 (production version). This comparison was prepared from data provided by the Soviet delegation which for the first time was participating in the working group on aircraft operations for supersonic transport which was organized by the OACI at Montreal between July 3-20 of last year. The "Concorde" figures were obviously obtained from French and British engineers of the BAC and of the company Aérospatiale. Even though the work must be approved by the Aerial Navigation Commission of the OACI, the numbers and performance graphs which we give here this week can be essentially considered to be quasi-official. The comparison is still incomplete in a number of areas, especially in the distance covered. The Soviets gave us insufficient data. This lack of accuracy is not astonishing. The calculations for the Concorde were done rigorously considering the large number of test flights, and they were subjected to a severe test by the companies which are buying the aircraft. This is not the case for the TU-144. /22*

On the Soviet side, the receivers are the builders and Aeroflot which at the same time are the judges and the participating parties. /23

* Numbers in the margin indicate pagination of original foreign text.



Typical payload/distance curve of the Concorde

The table given below and the graphs on this page do not show any astonishing results. For example, it can be seen that the TU-144 will effectively be slightly faster than the Concorde in the supersonic regime. In reality, the real difference will be smaller because, for the Concorde, Mach 2.05 corresponds to a limiting temperature of 400°K, 127° C in a standard atmosphere, that is, at -56.5° C in the stratosphere. Mach 2.35 in the standard atmosphere does not correspond to 420° K, (147° C): each time the Mach number is increased by 0.1, the temperature in this Mach number range increases by several tens of a degree C. The TU-144 would therefore only effectively cruise at Mach 2.35 while not exceeding 420° K in the "cold" atmosphere, 10° C below standard temperature. Thus the TU-144 will be limited by Mach number much more frequently than the Concorde. This will be due to an aerodynamic limitation as well as by excessive heating. This could reduce the lifetime of the airframe.

It should be noted that the TU-144 can withstand 20° C more temperature than the Concorde, apparently due to a more extensive use of titanium alloys (18° in the aircraft). This is especially used in the leading edges where the kinetic heating is greatest.

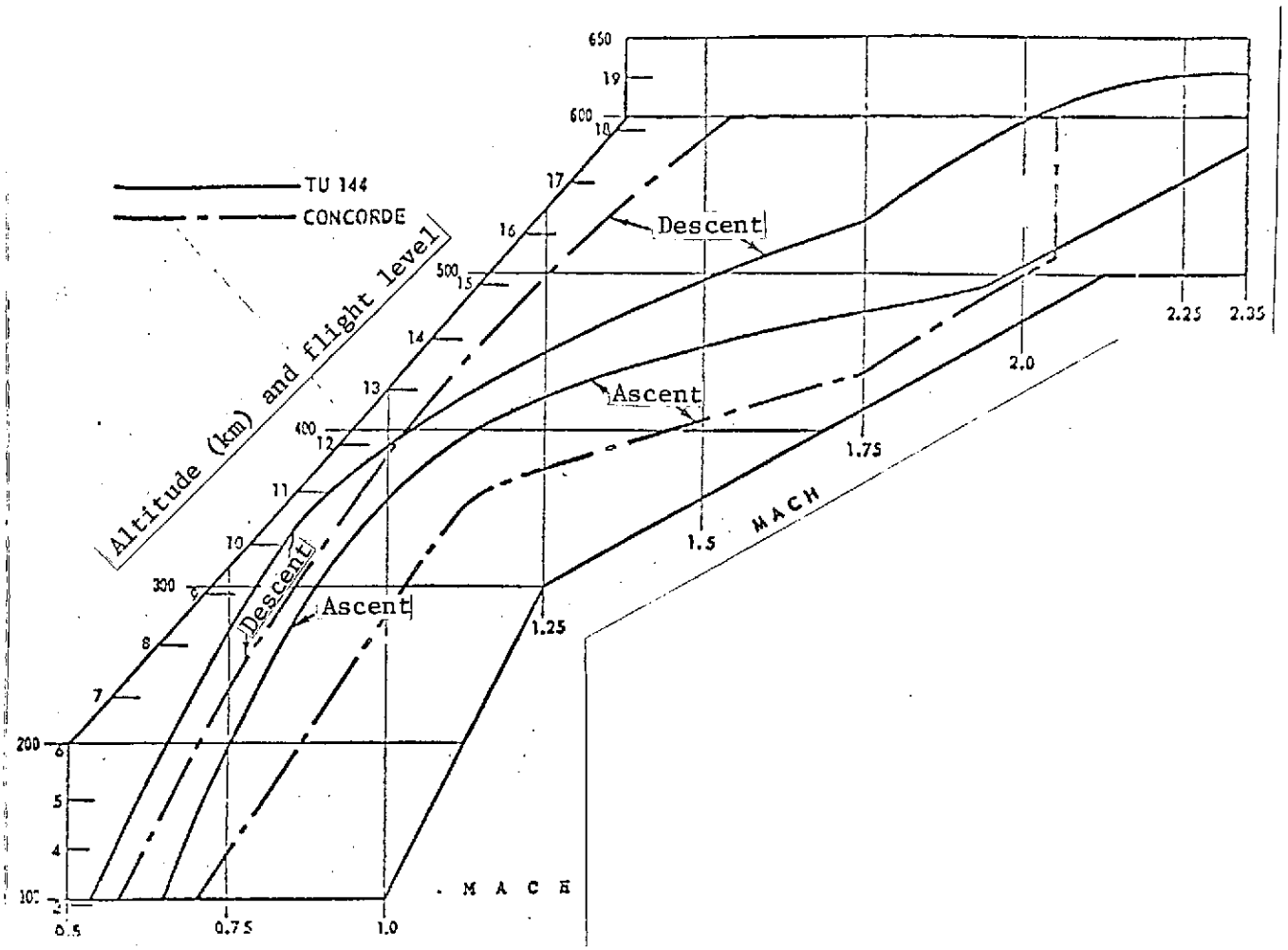
In addition, the Tu-144 will cruise about 1000 m higher than the Concourde. However, the calculation of the range for real operational conditions remains inexact. This is especially because the Soviets told us that one of their principle objectives is to reduce the duration of the cruising flight part (beginning)

Main performance item	Units	Concorde	Tupolev-144
Takeoff:			
Length of equivalent runway at maximum takeoff weight at sea level, A.T.I., approximate	m (ft)	3,124 (10,250)	3,000 (9,480)
Length of equivalent payload at maximum takeoff weight at sea level, A.T.I.+ 15° C, approx.	m (ft)	3,429 (11,250)	3,200 (10,510)
Takeoff velocity (V.C.) at maximum takeoff weight	kt (km/h)	217 (400)	194 (360)
Maximum velocity for the tires, (V.V.)	kt (km/h)	227 (420)	To be determined
Takeoff ascent velocity (V.C.) at maximum payload weight (176.4 tons for Concorde, 180 tons for the TU-144)	kt (km/h)	Acceleration from 250 kt (463 km/h) to 300 m (1,000 feet) up to 400 kt (740 km/h) at 1500 m (5,000 feet) then ascent at 400 kt (740 km/h) to flight level 361.	Acceleration from 200 kt (370 km/h) to 400 m (1,220 feet) up to 378 kt (700 km/h) at 2,000 m (6,560 feet)
Ascent: Subsonic ascent velocity to optimum cruise altitude (V.C.) Supersonic ascent velocity to optimum cruise altitude (V.C.)		See typical profile graphs (V.C. and Mach number as a function of altitude)	
Subsonic cruise:		Mach 0.93	Mach 0.93
Optimum altitude with 4 engines operating:			
- with increased weight	m (ft)	8,200 (25,000)	8,500 (27,300)
- with slightly increased weight	m (ft)	11,200 (36,000)	11,500 (37,600)

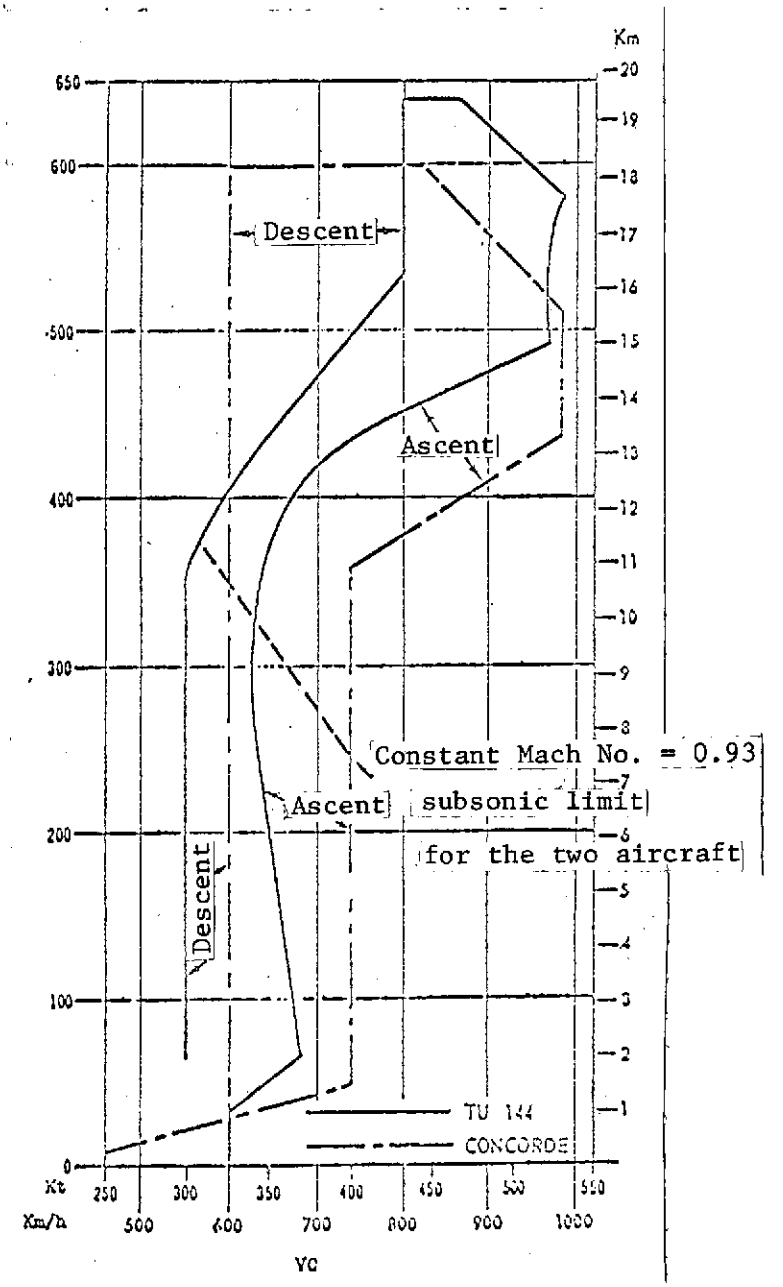
(Continued on next page)

Table (continued)

Main performance item	Units	Concorde	Tupolev-144
Supersonic cruise: Altitude at the end of flight Limits for supersonic regime: - operational maximum velocity V.M.O. - maximum operational Mach number M.M.O. - admissible temperature T.M.O. Turning radius at V.C., conditions A.T.I., with 30° lateral inclination	 m (ft) kt °K km (N.M.)	Mach 2.05 (A.T.I.) 18,300 (60,000) 530 2.05 400 63 (35)	(Mach 2.2 (A.T.I.) 19,000 (62,300) - 2.35 420 75 (42)
Descent: Typical descent velocities (V.C.)		See graph on typical ascent and descent profiles (Profile V.C. and Mach number as a function of altitude)	
Landing: Landing distance at maximum weight at sea level Optimum velocity at threshhold (E.V.) for maximum weight	 m (ft) kt (km/h)	 2,438 (8,000) 160 (296)	 2,600 (8,500) 146 (270)
Covered range: Maximum covered range with maximum weight at takeoff, full reserves, A.T.I. conditions, reserves not used. Covered range with maximum freight load, reserves not used	 km (N.M.) km (N.M.)	 6,830 (3,700) 6,200 (3,350)	 6,000 to 6,500 (3,245 to 3,510) -

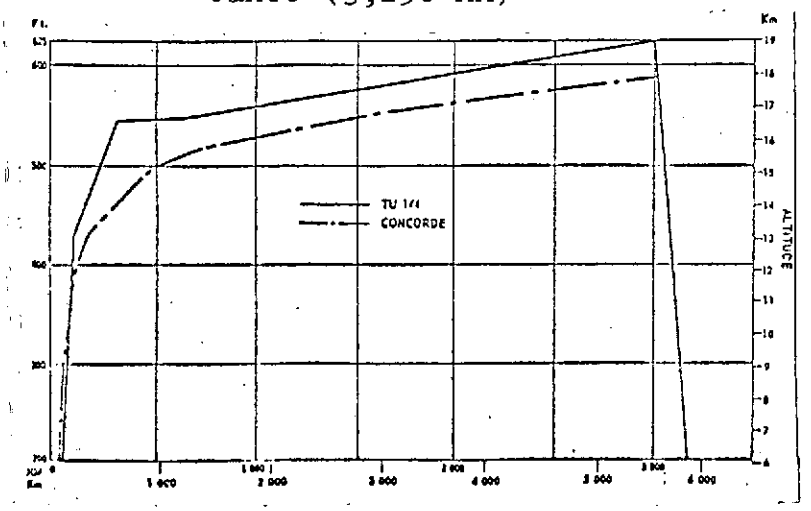


Mach number as a function of altitude for ascent and descent velocities of the two aircraft. Below and to the left, corrected velocity (V.C.) for the same profiles.



Typical ascent and descent profiles

Typical flight profiles of the TU 144 and of the Concorde over 6,000 km distance (3,250 MM)



Comparison of typical flight profiles for a 6,000 km distance

during which post-combustion is required, and during which a large amount of fuel is used.

The ascent and descent profiles of the two aircraft are quite different. At takeoff, in spite of a higher wing load (492 kg/m^2 instead of 411) and a thrust/weight ratio which is less advantageous (0.39 against 0.44), the Concorde will have runways which are slightly longer than those for the TU-144. For landing, the Concorde has the shorter landing distance. Without any prejudice, it can be said that the French-English aircraft is essentially equivalent to the Soviet aircraft in the low velocity flight range. This leads to the conclusion that the Eastern aerodynamicists have definitely succeeded in designing and producing an absolutely remarkable wing, which has exceptional flight qualities over the entire flight range.

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16. Abstract

Preliminary Soviet data and accurate French-English flight data are used to compare the performances of the Concorde and the TU-144 in the following areas: flight profiles, takeoff weight, range, payload capability, takeoff and landing distances.

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